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CONTENTS.

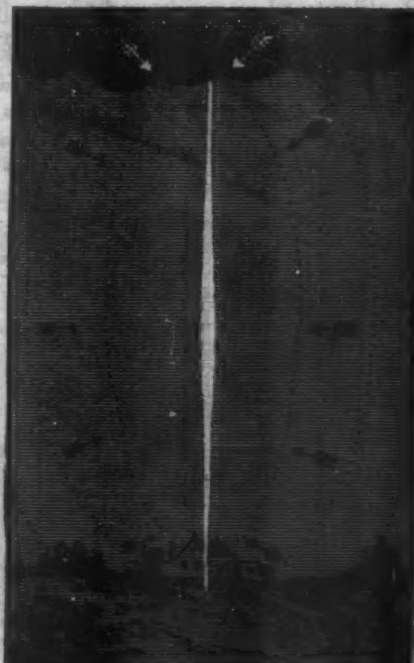
PROTECTION FROM LIGHTNING.

IS it not true that, in a vague way, the usual conception of the cause of damage by lightning is that something (in past ages a "thunderbolt") comes down from the thunder cloud to do the damage? Is it not true that since damage is done by lightning we should seek the mass of matter in which this energy must exist just before the flash? Is it not equally true that since Faraday's time we have known that this energy exists in the column of dielectric (mainly air) extending from the cloud to the earth? Do we not know since Lord Kelvin's experiments that this energy exists in the air on account of a state of electrical stress, which stress cannot exceed .0075 of a pound per square inch, and that consequently the amount of energy in each cubic foot of air cannot exceed about one foot-pound?

Knowing that the energy just before the flash exists in the column of air between the cloud and the earth, which column is indicated in the figure by the dotted lines, and that when the air "breaks down" and the flash comes this energy manifests itself mainly as heat along the central core of this column in what we call a flash of lightning, is it not evident that the energy must be transmitted in lines perpendicular to the lines of electrical stress, *i.e.*, in the main horizontally, indicated in the figure by the arrows?

From all this, which is a part of our current knowledge, it appears that the problem of protection from lightning is a problem in the dissipation of energy; that the energy to be dissipated, while we know it to be considerable, as broken masonry testifies, is but a small part of the whole involved in a flash of lightning, by far the larger part being dissipated as heat above the roofs of our houses. If the conditions can be so arranged, by the use of considerable masses of metal suitably placed, that there shall be no state of stress below the roof of the house, then there will be no energy to be dissipated below that level, and all will go well. But it is surely time that the problem of protecting buildings from lightning should be looked upon as one in energetics and that it should be appreciated that the energy present cannot be hocus-pocused out of the way but must be dissipated in some harmless manner.

The deflagration of a pound or two of thin copper ribbon dissipates a large amount of energy, how much we do not know, but experience shows it is so large that too little is left to do other damage when a house is struck by lightning. This lightning protector, manufactured under patents of N. D. C. Hodges, Editor of *Science*, is sent prepaid to any address on receipt of $5.00 per 100 feet. The amount ordered should be sufficent to run lines of the protector from the highest to the lowest points of the building, at intervals of about forty feet. Any carpenter can put it on.



AMERICAN LIGHTNING
PROTECTION COMPANY,
874 BROADWAY, NEW YORK.

QUERY.

Can any reader of *Science* cite a case of lightning stroke in which the dissipation of a small conductor (one-sixteenth of an inch in diameter, say,) has failed to protect between two horizontal planes passing through its upper and lower ends respectively? Plenty of cases have been found which show that when the conductor is dissipated the building is not injured to the extent explained (for many of these see volumes of Philosophical Transactions at the time when lightning was attracting the attention of the Royal Society), but not an exception is yet known, although this query has been published far and wide among electricians.

First inserted June 19, 1891. No response to date.

N. D. C. HODGES, 874 BROADWAY, N. Y.

SCIENCE

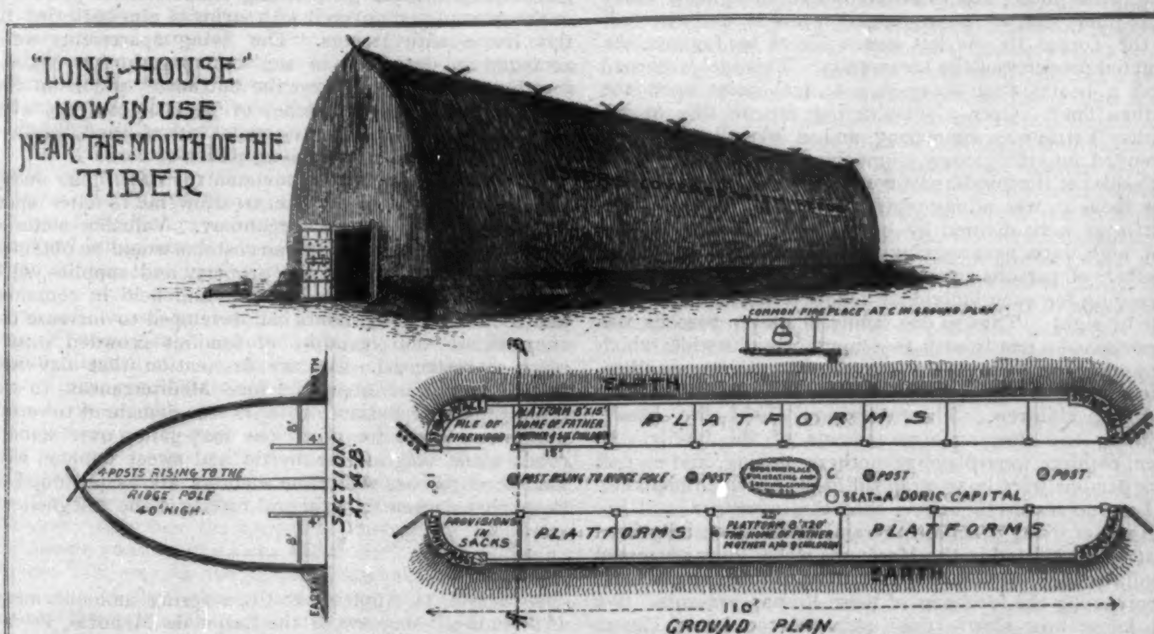
NEW YORK, MARCH 2, 1894.

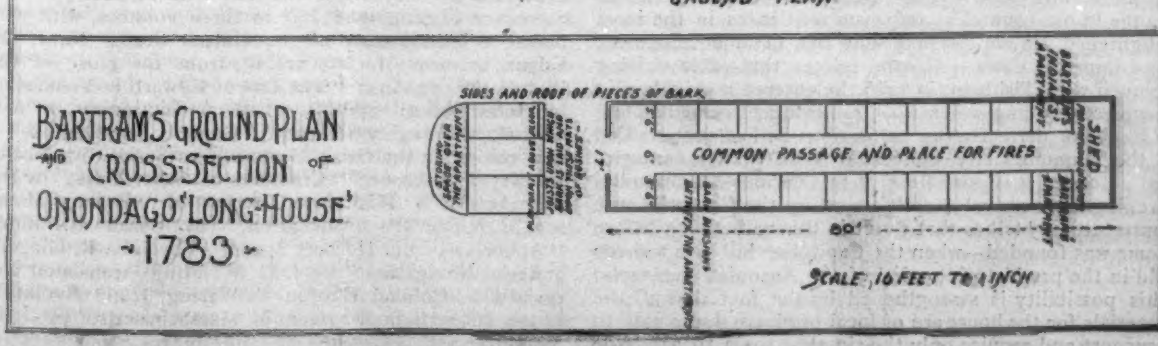
SOME ITALIAN "SURVIVALS"—A "LONG-HOUSE" IN THE TIBER DELTA.

BY ROBERT H. LAMBORN, PH.D.

AROUND the Eternal City, within easy riding distance, one may study many surprising phases of civilization. Six miles north-eastward across the Campagna from the Porto del Populo, in a secluded valley far from the beaten roads, on the lands of Prince Borghese, I found several families numbering 26 persons, living in caves with their shaggy white dogs. They subsisted by gathering wild chiccory for Roman salad-eaters, and by begging for alms at the city gates. A furlong from this cave is a veritable cliff dwelling. A deep cavity in an almost perpendicular escarpment of tufa rock is reached by a zig-zag path. Its entrance is closed by a swinging bundle of bush, and within, the irregular floor is divided by rough stone walls into pens resembling those in a Colorado cliff-dweller's habitation. On the western slope of the Alban Hills I once dismounted to inspect a flour mill owned by the Cenci family, where the vertical shaft of a horizontal flutterwheel carries the diminutive grinding stone and the water flowing from a historic Etruscan drainage-tunnel shoots down a steep stone channel, and dashing out a sparkling shower, whirls the toy-like wheel with all the prettiness and childish carelessness of force-expenditure that one may see in a New Mexican Indian corn-mill. The shepherds on the broad domain of Prince Torlonia live in beehive-shaped *capanne*, built of brush and reeds almost as simple in construction as the dwelling reared by our western beaver. Their rent they pay weekly by selling ewes' cheese, made over a fire kindled on the earthern floor close to the bunk in which the shepherds sleep.

On April 13, 1888, I rode by the Via Ostia, through the Tiber Valley, to the district where that river divides and enters the Mediterranean. I reached, not far from the sea, the property of Prince Aldobrandini and soon approached his country seat, near which arise





four curious and conspicuous structures, in close proximity to the roadway. At first they seemed to be huge haystacks, the stored herbage of Tiber's fertile delta, but nearer inspection proved them to be houses. It was quickly evident, too, that they did not lack inhabitants, for a number of women and children flocked from an opening in the eastern end of the largest structure, and stood awaiting my approach. I was so strongly reminded of the "Long House" of the Onondaga Indians as given by Morgan (after Bartram) in his "House Life of the American Aborigines," that I handed my reins to a young man who had approached expectantly and entered the open doorway; men and women coming forward with alacrity to show me the interior economy. I was told that this, with the three additional structures, were the dwellings of the laborers on the Aldobrandini estate, and that about 70 of the total population of about 250 found in this house their home. Its form is best shown by the accompanying sketches made in my note book on the spot. It is 110 feet long, about 26 feet wide, and is drawn to a comb about 40 feet above the ground. Vertical and horizontal poles form the framework, upon which are fastened osier walls, overlaid by flags and reeds gathered from the neighboring lagoons, thus producing a wind and rain proof covering. The storms and sunshine of years falling upon this thatch of water plants gradually change their color until the exterior is as black as a stack of clover hay. Only two openings, one at each end, admit you to this windowless house, and these are closed at night by heavy plank doors that are swung together and securely barred. In the corner to the left was a pile of dry faggots, the common property of the community. This fuel is burned upon a hearth that occupies a central point upon the earthen floor. Over a smouldering fire on this hearth a brass kettle was simmering, and a wreath of smoke ascended into the gloomy chimneyless upper-spaces. On both sides of the middle passage way, and raised about four feet above it, was a long platform of rough plank. These platforms were divided by board partitions, about three feet high, into pens varying in length according to the number of persons intended to be accommodated, but averaging for each individual a floor space of about two feet by eight. Thus to one family of eleven persons was apportioned a pen twenty feet long by eight wide, which answered for them every purpose of a home: another, fifteen feet by eight, was occupied by a father, mother and six children. These divisions held the boxes, clothing and sleeping arrangements of the family. In them children were playing, mothers nursing, and several sick persons were lying wrapped in dark woolen blankets.

I see no reason to believe that this structure, and the method of living practised therein, varies essentially from that which existed in the Maremma when Pliny possessed a villa near this spot, and when Cæsar drew his soldiers from among the forebears of these Roman peasants. We all know how slowly the habits of the lower classes change in old countries, and even residences in the most enlightened Italian districts show but little development since imperial times. Göethe relates that after visiting Pompeii with Tishbein, in 1787, he entered a neighboring occupied dwelling which with its furniture seemed to him to resemble perfectly the habitations he had just studied in the mummied city, built more than twenty centuries ago. Indeed it is possible that this curious Aldobrandini dwelling is a survival closely imitating the form of house constructed by tribes that dwelt in this valley long before Rome was founded—when the Capitoline hill was a sheep fold in the pre-historic period of the Ausonian peninsula. This possibility is strengthened by the fact that all the materials for the house are of local production, are easy to transport and require only the simplest tools to assemble and erect, while the result is an enduring and excellent shelter. An additional and striking evidence of the aboriginal character of the structure is the close parallelism shown in the American "Long House" already mentioned, which was habitually built and inhabited by some of our best known savage tribes. For purposes of comparison I have reproduced here Bartram's sketch of the Onondaga "Long House," made on the occasion of his visit to attend a council of that tribe in 1743. It was 80 feet long and 17 feet wide. A common passage, in which the fires were built, ran between two sets of occupied apartments. These apartments were raised about a foot above the level of the passage on two platforms made of hewn saplings, that extended along both sides of the house. They were formed by erecting bark partitions upon the platforms, and one division was allotted to each family. Soft pieces of dry bark and sleeping-mats were spread upon the rough floor, and a fire for each four apartments kept the house warm and served for cooking. Above each fire a vent in the roof allowed the smoke to escape. Extending over the apartments was a sort of second story in which household effects could be deposited. A corner in this dwelling was devoted to the common store of firewood.

"Long Houses," resembling the one pictured by Bartram, are described by Greenbalge, who visited the village of the Iriquois-Senecas near the present site of Rochester, in New York, in 1677. One was about 100 feet in length, made of a strong framework of poles set in the ground and covered with strips of elm-bark tied to this frame with strings. The living apartments were arranged as described in the Onondaga house. Skins, forming curtains, hung over the entrances, and from the roof were suspended bunches of Indian corn ears with their husks braided, and festoons of bits of dried squashes and pumpkins strung upon long pieces of cord.

My visit to this cheerful community in the Tiber delta, I regret to say, was too brief to allow me to enter upon the study of its domestic economy. Valuable material for comparison with the Indian customs would be obtained by investigating how far the property and supplies, such as firewood and food, are procured and held in common, and what household habits had developed to increase the convenience and comfort of families crowded into a place so restricted. But my destination that day was further southward along the blue Mediterranean, to the beautiful Castle Fusiano, with its vast domain of towering pine trees, where for miles one may gallop over smooth roads made fragrant by myrtle and sweet daphne, with long level reaches where the shadows are as profound as those that darken the primeval forests of the Alleghenys.

—Messrs. D. Appleton & Co.'s spring announcements include the "Memoirs of the Baron de Meneval, Private Secretary of Napoleon I.," in three volumes, with portraits; "The History of the United States Navy," by Edgar Stanton Maclay, vol. ii., from the close of the War of 1812 to 1894; "The Life of Edward L. Youmans," by John Fiske; Smith's Classical Dictionary, a new edition, thoroughly revised; "General Washington," a new volume in the Great Commanders Series, by General Bradley T. Johnson; "Creatures of Other Days," by the Rev. Dr. H. N. Hutchinson, author of "Extinct Monsters"; "Symbolic Education," by Susan E. Blow; "Aphorisms from Herbert Spencer," by Julia R. Gingell; "Aërial Navigation," by J. G. W. Fijnje, translated and revised by Colonel George E. Waring, Jr.; "Evolution of the Public School System in Massachusetts," by G. F. Martin.

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Attention is called to the "Wants" column. It is invaluable to those who use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers may go directly to them. The "Exchange" column is likewise open.

MEMORABILIA BOTANICA, II.

(*Edited by Erwin F. Smith, B.S., D.S., Washington, D.C.*)

A JOURNEY INTO THE TROPICS.

IN recent years the botanical garden at Buitenzorg, Java, has become a sort of Mecca for European botanists. Solms-Laubach, Schimper, Goebel, and many others have there studied tropical vegetation. Probably no other botanical garden in the tropics offers as good facilities for study, and certainly no other is so well-equipped, has been used as extensively or has been productive of anything like as much good work.

One of the results of a sojourn at Buitenzorg is a new book of 300 pp. by Dr. Haberlandt ("Eine Botanische Tropenreise") giving travel sketches and graphic accounts of the Indo-Malaysian vegetation. The author has not confined himself to dry dissertations, but has had his eyes open to the biological side of botany, has known how wisely to omit, and has mixed in enough general observations and human interest to make a readable book and one of considerable general interest, even without the useful illustrations of characteristic vegetation, reproduced from pencil drawings. To describe all the interesting things in this book would be nearly equivalent to translating it. It must suffice, therefore, to call attention to some of the leading features. The book begins with the departure from Triest; gives a chapter or two on the outward voyage, including some account of Bombay; describes the garden at Buitenzorg; discusses its climate and devotes a chapter to each of the following topics: The tree of the tropics, tropical foliage, flowers and fruits of the tropics, lianas, epiphytes, tropical ant-plants, the primeval forest, the mangroves, etc. The reader will also find fresh and interesting notes on a variety of cultivated plants,—tea, coffee, rice, cocoa-nut, cinnamon, cinchona, banana, etc. Various excursions into the island are described, and one chapter is devoted to the animals of Java and another to the inhabitants,—their language, customs, amusements, etc. On the return journey Dr. Haberlandt spent a few days in Ceylon and finally crossed the Arabian desert in Egypt, already classic ground by reason of the admirable researches of George Volkens on the adaptations of the desert flora.

Not least attractive is the poetic and artistic feeling and the strong personal element that pervades the book. The following are some of the things that attracted special attention: The extent to which variegated leaved plants have been substituted for flowers in tropical landscape gardening; the broken contour of the forest, certain species towering far above the rest and noticeable at a long distance; the general whiteness of the tree trunks; the preponderance of woody growths; the form of branching, in many cases quite unlike that of European trees; the very rapid pushing of leafy shoots which hang down, pale or reddish, weak and limp, until they have reached full size and then gradually become green, erect and self-supporting; the nearly uniform absence of periodicity in leaf fall; the marked tendency of the foliage to be entire, smooth and coriaceous, to which is often added a lacquer-like lustre; the dazzling reflected light of tropical foliage, in striking contrast with the mild transmitted light of European foliage; the numerous modifications of leaves and changes of position to avoid very intense light; the enormous assimilative power of individual leaves and the comparatively small number on a tree; the excessive brightness of the sky and the great amount of light in the interior of a tropical forest, the shade being not nearly so dense as in an European beech wood; the enormous vegetative activity, the sharp struggle for light, and the occupancy in the forest of every available foot of space, an almost impenetrable thicket on the ground, epiphytes and lianas on the trunks of trees in great profusion lifted up out of the surface tangle, and individual trees reaching the necessary light by expanding their tops above the rest of the forest; the general lack of protective adaptations against cold, so that one comes to understand the full meaning of many northern modifications only after he has studied the tropical vegetation; the very rapid growth (in young trees frequently as much as five metres a year), which takes place in an atmosphere so moist that transpiration is greatly diminished or at times stopped altogether, and which goes to show that there is no necessary connection between the transpiration stream and the upward movement of plant foods from the roots, osmotic action being sufficient to bring it about; the noticeable absence of palms from the forest; the curious adaptations to conserve moisture, roots within pitchers, etc.; the occurrence of breathing roots in the swamp plants, *Sonneratia* and *Avicennia*, and of bracing roots in many trees, in *Sterculia* enormously developed; the numerous extra functions of tropical roots, most striking of all "the change of the aërial roots of various Orchideae into green, ribbon-shaped organs of assimilation" (*Tæniophyllum Zollingeri* has no other); the preponderance of bright colors in tropical flowers (white, yellow, orange, and bright red) and the rarity of blue flowers; and, finally, the many leaves, stems, etc., in which a particular form seems to be of no value to the plant but has been retained because not harmful, the hypothesis being put forward that many of these forms, not all, are mere "Luxus Anpassungen," due to the internal energy of the plant, and are not modifications brought about by external agencies, such as food and climatic changes, the author pointing out that the multiplicity of these variations is greatest in the places where, according to the Darwinian law, they should be least, viz., in the tropics, where the climate varies but little,—"Zwecklose Blattgestalten und ebensolche Verzweigungsformen, phantastischsinnlose Blütenmodelle und tausend anderer morphologische Eigenschaften, die nutzlos sind, bleiben erhalten weil ihre Ausmerzung kein unbedingtes Erforderniss für der Fortexistenz der betreffenden Pflanzen war."

This is a volume to go on the shelf with Schimper and Goebel, but not until it has been read and enjoyed from cover to cover.

PARASITIC ALGAE.

ONE of the most interesting botanical finds during the Madison meeting of the A. A. A. S. was made by Mr.

W. T. Swingle at the Dells of the Wisconsin River, where an endophytic alga was discovered in the leaves of the common Indian turnip (Arisaema triphyllum). This parasite causes white spots, which are often one-half inch or more in diameter and in which the bright green threads of the alga are distinctly visible with a low power objective or even with a good hand lens. From Wille's description and illustrations of Phyllosiphon arisari (in Engler and Prantl Nat. Pflanzenf.) this would seem to be that species. Heretofore it has been known only from the leaves and stems of Arisarum vulgare in southern France and some parts of Italy, being first described by Kühn in 1878.

Another algal parasite, Mycoidea parasitica, was described at the same meeting, having been discovered by Mr. Swingle in Florida, where it forms rusty patches on the leaves of Xanthoxylum. This was first described by Cunningham from the leaves of various tropical land plants and is figured by Wille (l.c.) This plant is also new to the United States, and its discovery, with that of the Phyllosiphon following so close upon its heels, suggests the probability that other of our land plants are parasitized by algae, especially in damp situations, aud that many interesting discoveries will be made now that attention has been called to the subject. Mr. Swingle's suggestion that the parasitic phycomycetes, *e.g.*, Peronospora, may have been derived from some such land forms rather than from the water-loving algae, appears to be worth considering. The effect of the Phyllosiphon on the Arisaema leaf suggests a fungus, and it would certainly be considered one but for its chlorophyll.

VEGETABLE FERMENTS.

MR. J. R. GREEN in *Annals of Botany* (March, 1893), has a long paper on vegetable ferments, embodying a digest of the present state of our knowledge. "Provisionally," says the author, "these bodies may be classified according to the materials on which they work. We may thus make four well-marked groups, excluding those which are obtainable from micro-organisms, as well as one or two whose action has not been thoroughly investigated. These groups will be: (1) Those which attack carbohydrates. These will include the different varieties of diastase, the ferment transforming inulin, the invertase which breaks up cane-sugar, the cytohydrolysts attacking cellulose, and the ferment which forms vegetable jelly from pectic substances. (2) Those which decompose glucosides, with formation of sugar and various aromatic bodies. Of these the best known are emulsin or synaptase, myrosin, erythrozym, and rhamnase. (3) The proteohydrolytic group, including vegetable pepsin, trypsin, and rennet, resembling very closely the animal enzymes bearing the same names. (4) The enzyme that decomposes oils or fats." The common or translocation *diastase* has a wide distribution in plant cells, and Barenetzky suggests that it is universally present so long as the cells are living. It slowly dissolves starch, converting it into sugar. A more active form known as diastase of secretion destroys the starch grain by corrosion. It occurs in various grains but only at the commencement of germination, being apparently secreted by the epithelial cells of the scutellum, but according to Haberlandt by the aleurone layer in the barley grain. *Inulase* occurs in the artichoke, dahlia and various other Compositæ. It first appears in the germinating tubers, converting the inulin into sugar. *Invertase* occurs in a variety of vegetable substances,—yeast, bacteria, fungi, malt, buds and leaves, pollen, grains, etc. It has the power of inverting or hydrolysing cane sugar into dextrose and laevulose. It occurs also in animals. A *cytohydrolytic* ferment probably occurs in the endosperm cells of palm seeds, but no one has yet been able to isolate it. The author cites De Bary's well-known experiments on the extrusion of a cellulose dissolving substance from the hyphæ of certain Pezizas, and Marshall Ward's on the lily Botrytis, and thinks that such bodies are not exceptional in the vegetable kingdom. Brown and Morris have discovered a similar enzyme in germinating barley grains. *Pectase* occurs in a variety of plants, carrots, beets, fruits, etc., and has the power of converting cellulose into gum. *Emulsin* occurs in certain Prunoideæ in the vicinity of the fibro-vascular bundles. It decomposes amygdalin into sugar, benzoic aldehyde, and prussic acid, and also decomposes many other glucosides. *Myrosin* is the characteristic enzyme of the Cruciferæ, but is probably not confined to this order. It breaks up the very complex glucosides abounding in Cruciferous plants into sugar and certain strong-smelling compounds generally containing sulphur. This enzyme occurs in special cells variously distributed. The strong smell of black mustard seed when bruised and covered with water is due to the liberation of sulphocyanate of allyl from contact of this enzyme with the glucoside, sinigrine, contained in other cells of the seed. *Rhamnase* occurs in the seeds of the Persian berry, Rhamnus infectorius. It decomposes a glucoside, xanthorhamnin, into glucose and a bright yellow dye, rhamnetin, the glucoside occurring abundantly in the pulp of the fruit and in the pericarp. Attention was first drawn to this enzyme by the discovery that decoctions of the pericarp alone would not produce the dye but that it developed at once when mixed with a little of the crushed seed. Subsequently Marshall Ward found out that the enzyme was located in a very small part of the seed, viz., the raphe, and that no other part of it would decompose the glucoside and produce the dye. *Erythrozym* occurs in the madder root, and there are yet other glucoside-enzymes, but less well known. *Pepsin*, or ferments very closely resembling it, and provisionally to be classed with it, occur in Drosera, Dionæa, Pinguicula, and other insectivorous plants. Probably the ferments found in Nepenthes, Sarracenia, and Aethalium sapticum also belong here. They are capable of dissolving proteids, connective tissue, cartilage and gelatine, and are most active in a slightly acid medium, strikingly resembling in these particulars the pepsin of the stomach. *Trypsin*, capable not only of converting proteids into peptone but also of breaking up the latter into amide bodies, occurs in the pawpaw (Carica papaya), the fig, and a melon (Cucumis utillisimus), the natives of India having for a long time made use of this fact by cooking certain fruits with tough meat to make it tender. A similar enzyme exists in the juice of the pineapple, in the seeds of vetch, hemp, flax, barley, castor beans and lupins, at the time of germination. Daccomo and Tommasi have also described a proteo-hydrolytic ferment from Annagallis arvensis, the fresh plant disintegrating fresh meat or fibrin in thirty-six hours when kept in contact with it at 60° C. *Rennet* occurs along with trypsin in commercial papain, in the juice of the pineapple, and in the seed of Ricinus. It has also been extracted in recent years from a variety of seeds, some before and others during germination. Lea has given quite a full account of its preparation from the seeds of Withania coagulans, a Solanaceous shrub of Afghanistan and northern India, and the author has found it in seeds of Datura Stramonium, Pisum sativum, Lupinus hirsutus, etc. It also occurs in the pericarp, pulp, and expressed juice of the ripe fruit of the Naras (Acanthosicyos horrida), a Cucurbitaceous plant of South Africa. The power of curdling milk also exists in the flowers of Galium verum, a plant still used in west England by cheesemakers; in the leaves of Pinguicula vulgaris, first noted by Linnaeus as in use by Lapland tribes for this purpose, and said by Pfeffer to be still used in the Italian Alps; in the glands of Drosera, noted by

Darwin; in the stem of Clematis vitalba; and in the petals of the artichoke. *Fatsplitting enzymes* have been discovered in seeds of Ricinus, rape, opium-poppy, hemp, flax and maize. In the castor bean it is distributed throughout the whole endosperm.

These ferments seem to arise from vegetable zymogens, the existence of which was first established by Vines in experiments on Nepenthes. The constitution of enzymes is still in dispute. Loew, as the result of analyses, considered them to be proteids closely allied to the peptones, but spectrum analysis and other evidence has now made this doubtful. Vegetable ferments are readily destroyed by boiling, and are for the most part very sensitive to acids and alkalies, a slight excess destroying them or stopping all action. They are not readily identified in tissues by use of stains. Some are very unstable. Enzymes have very slight power of diffusion. They can make their way through cell walls, but not through the parchment walls of dializers. They appear to act in an ordinary chemical way, causing hydration (myrosin excepted) and subsequent decomposition. Most of the changes brought about by enzymes can be effected in the laboratory by ordinary chemical processes. They are extracted for experimental purposes by water, salt water, or glycerine, and are quickly precipitated by excess of alcohol. One of their most striking peculiarities is the enormous power of conversion they possess, a sample of invertase being capable of inverting 100,000 times its own weight of cane sugar without injury to itself. The ferments of the fungi and bacteria are also enzymes, and the old view of Naegeli that there are two distinct classes of ferments, organized and unorganized, is no longer tenable. Enzymes have been isolated from a number of bacteria, and even several from the same organism,—in case of the potato bacillus, B. mesentericus vulgatus, no less than five, viz., diastase, invertase, rennet, a proteohydrolytic enzyme and one destroying the middle lamella of vegetable cells.

MAPLES.

In an interesting paper on "Sugar Maples, and Maples in Winter" (Repr. from Fifth Annual Report, Mo. Bot. Garden), Dr. Trelease discusses the synonomy of certain species which has shifted about a good deal of late. He recognizes the western sugar maple as Acer grandidentatum Nuttall; the eastern, as A. saccharum Marshall with two varieties, barbatum (Michx.) Trelease, and nigrum (Michx. f.) Britton; the southern, as A. Floridanum (Chapman) Pax, with variety acuminatum Trelease.

The second part of the paper describes the winter appearance of all our species, the difference in bark, leaf-scars and buds being ample for their determination. The paper is accompanied by sixteen plates illustrating twigs, leaves and fruits. It was written partly for teachers, and it is to be hoped that it may find its way into the hands of a good many. Certainly there are hundreds who have no idea how interesting a study can be made out of bare twigs, and to whom this paper would prove very serviceable.

THE FOSSIL FLORA OF S. E. FRANCE.

In May, 1893, at the Montpellier meeting of the Botanical Society of France, M. Saporta read a paper of twenty pages (recently published in Bull. de la Soc. Bot. d'France) showing the relationships of the living flora of Provence to that found in the rocks, especially of the Aquitanian. In the author's own words, his conclusions are not drawn from simple and vague analogy, nor even from a more or less close morphological similarity, but rather from resemblances so close (*intime*) as to be indications of a genuine filiation. In other words he supposes the living forms in question to be the direct descendants from those whose fragments have been found in a fossil state. Only woody plants are considered, since herbs have left but insignificant vestiges too scanty for throwing any light on problems of descent. As preliminary to this consideration it should be borne in mind, first, that the farther back we go the fewer and the more vague and general are the resemblances of fossil plants to living ones, and, second, that the earliest relationships close enough to be considered filiative are with exotic species, growing generally in more or less restricted areas. Descendants of other early forms still occur in France but often in exceptional conditions of isolation and retreat. In more recent times, *i.e.*, toward the mio-pliocene, the flora changed gradually, the palms, laurels, magnolias, etc., which had long dominated, giving place to new elements probably derived from the north. These new-comers were principally oaks, of the Robur group, poplars, maples, and lindens. Then only did the vegetation of central and southern Europe begin to resemble its present condition. The most ancient flora considered by M. Saporta is from the gypsum beds of Aix, which belong to the uppermost horizon of the Eocene. They have been explored for twenty years, and about 500 species are known. Fourteen species now indigenous to southern France so closely resemble forms from these beds as to be considered their lineal descendants. These are: Ostrya carpinifolia, Quercus Ilex, Quercus coccifera, Olea Europæa, Fraxinus oxyphylla, Nerium Oleander, Styrax officinale, Hedera Helix, Cornus mas, Paliurus aculeatus, Pistacia Terebinthus, P. Lentiscus, Rhus Coriaria, and Cercis Siliquastrum. Other types occurring in these beds are now represented only by exotic species, *e.g.*, Callitris quadrivalvis in Algeria, Zizyphus spina-Christi in Tunis, Myrsine retusa in the Canaries, Amygdalus communis in Asia minor, and species of Ailanthus and Catalpa in eastern and southern Asia. In the oligocene many additional relationships appear. Notable among these new-comers are the ancestral forms of the California Sequoia, the N. Am. Taxodium, and the Chinese Glyptostrobus. These first appear in England and subsequently in southern France. The greatest interest, however, centres in the Aquitanian flora. From the Manosque beds of this horizon there are no less than thirty ancestral forms of exotic species. These species, although long excluded from France, have varied so little that they cannot be separated from their presumed ancestors. Among them are Sequoia sempervirens in California, Sabal umbraculifera in America, Myrica salicina in Abyssinia, M. sapida in Nepaul, M. Faya in the Canaries, Betula cylindrostachya of interior Asia, Alnus subcordata of the Caucasus, Carpinus viminea of Nepaul, Fagus ferruginea of America, Populus Euphratica of Algeria, Syria and Palestine, Zelkovia crenata of the Caucasus, Z. Protokeoki of Japan, Persea gratissima of the Tropics, Nelumbium speciosum of southern Asia, Magnolia grandiflora of Louisiana, Acer cratægifolium of Japan, Acer rubrum of America, A. rufinerve of Japan and A. sp. of interior China, Berchemia volubilis of America and an unnamed similar species from Yunnan. Among the species which, with slight modifications, have held their own in southern France from the Aquitanian down are the following: Juniperus Oxycedrus, Smilax mauritanica, Alnus incana, Carpinus orientalis, Ostrya carpinifolia, Fagus silvatica (through one or several intermediate forms in the mio-Pliocene), Salix fragilis, Populus nigra, P. alba, P. Tremula, especially Asiatic varieties of the type Tremula, the southern variety of Ulmus montana, Laurus nobilis, Fraxinus oxyphylla, Olea Europæa, Styrax officinale, Acer opulifolium, A. Opulus, A. campestre, Rhamnus frangula, and Cydonia vulgaris. The Aquitanian is still a long way from modern times. In the pre-

dominance of Palmaceæ Lauraceæ, Magnoliaceæ, Cedrelaceæ, Sapindaceæ, and arborescent Leguminosæ; in the presence of such genera as Engelhardtia, Ailanthus, Bauhinia, Lygodium, and Chrysodium; and in the frequency of Cinnamomum, Persea, and species of Myricaceæ, Cesalpineæ, and Mimoseæ we are introduced to a vegetation which is certainly very different from that now existing in southern France, and the contrast would be complete were it not that these types are associated with genera still indigenous, such as Alnus, Betula, Carpinus, Ostrya, Populus, Salix, Ulmus, and Acer. The tropical and sub-tropical types were eliminated during the course of the Pliocene, and the other types became variously modified, as shown by a series of intermediate forms extending from the Aquitanian down to recent Pliocene. Another fact of interest is that the greater number of the European descendants of these ancient floras belong exclusively to the Mediterranean flora, while many occur only in isolated localities and seem to have but a slender hold upon the region. The absence of certain species which form an integral part of the present flora lead to the belief that they appeared later than the period represented by the Aquitanian of Manosque. Toward the mio-Pliocene a new alluvion containing vegetable forms was superposed on the preceding, and this was correlative with a partial ellimination of species which Europe had possessed until then. Up to and including the Aquitanian there are no vestiges in southeastern France of any of the following types: Alnus glutinosa, Coryllus Avellana, Carpinus betula; the Robur, Toza and Infectoria sections of Quercus; Platanus, Liquidambar and Liriodendron; Ficus carica; Tillia, Carya, and Pterocarya; Ilex aquilifolium, Acer Pseudoplatinus, A. platanoides, Sorbus torminalis. These came in at a later date and in most cases apparently from the north, appearing lower down in formations further to the north. In the Swiss Helvetian there is a Pterocarya which nothing distinguishes from a living species of the Caucasus, and a Liriodendron scarcely distinct from that of America. The Platanus aceroides seems to have followed the same course as the Tertiary tulip tree, both species growing together in mio-Pliocene times in the valley of the Rhone. The last part of the paper is taken up with a critical consideration of the southern European oaks based on a study of material from the mio-Pliocene beds of Italy and France, in which there are species of the following sections of the genus Quercus,—Cerris, Ilex, Toza, Robur, and Infectoria. The paper is accompanied by three lithographic plates and two figures in the text.

THE BOTANICAL LANDSCAPE.

BY J. W. CHICKERING, NATIONAL DEAF-MUTE COLLEGE, WASHINGTON, D. C.

If there be among either the older or the younger botanists of our country any who, in these days, when so much attention is paid to laboratory work, microscopic investigation, discussion of the laws of nomenclature and other theoretical inquiries, still retain interest in field work, and are not afraid of being considered "mere collectors," I should like to suggest one direction in which there is still opportunity for observation and record.

Distributive botany has always had its fair share of attention. We are familiar with the change in the vegetation, as we go from the equator to the poles, or from sea level to the snow line on our loftier mountains. Our catalogues present us with the percentage of change in the flora, as we pass from New England either west or south. But little has been said in either manuals or local catalogues about what might be called the botanical landscape of different localities. By this is meant a recognition of those species occurring so in mass as to give color and character to the whole landscape, even when seen from a carriage or a railway train.

Our ordinary idea of a local flora is the whole number of species detected by the careful and skilled botanist, in the narrow ravine, or underneath the dark shadows of over-hanging cliffs, or over-arching forests. But I wish now to suggest, especially to those who may edit future manuals or local catalogues, the desirability of noting those plants which thus form a conspicuous part of the landscape, and moreover of noting and recording the gradual change of species, as, for instance, among the *Solidagus* and *Asters* in passing from one section to another.

As an example, I will give a few notes of such social and colonizing species as attracted attention during two or three summers in eastern Maine and Nova Scotia. Many of our sub-Alpine plants here descend from the mountains and take possession of the soil near the level of the sea. Notably is this the case with *Empetrum nigrum*, covering the swamps, intermixed with *Ledum latifolium*, and *Rhododendron rhodora*, and in a few localities *Rubus chamaemorns*, the cloud-berry, sufficiently abundant to have its fruit brought to market, under the name of baked-apple, though, according to Mr. Kennan, much inferior in flavor and juiciness to the same species as found so abundantly on the Siberian steppes.

Along the valley of the Cornwallis River, for miles on either side the railroad, are masses of *Corema conradi*, and all through eastern Maine *Vaccinium vitis-idaea* is the most abundant, as it is the most aromatic in flavor of all the cranberries.

In eastern Nova Scotia a European species, *Senecio jacobaeus*, the ragwort, was noticed as replacing and exterminating the native *Solidagos*, and likely to become a troublesome weed, if it holds on its westward way.

In eastern Massachusetts are seen occasionally patches of *Genista tinctoria*, wonderfully brilliant on Salem hills, and less abundantly *Galium verum*.

In some parts of western Massachusetts, *Potentilla fruticosa* is similarly conspicuous, but a most pestilent invader, over-running and ruining hundreds of acres of good pasture land.

Down in the Shenandoah Valley, in Viginia, the traveller's attention is arrested by the great masses of *Echium vulgare*, known as blue thistle, not only diversifying the landscape with its cerulean hue, but supplying honey to millions of bees.

Perhaps the most beautiful sight I ever beheld of this sort, was along the banks of the Carrabasset River, in Maine, where for four miles *Epilobium angustifolium*, one of the many plants known as fire-weed, covered the ground, reaching a height of three or four feet, and rising and falling with every inequality of the surface, suggesting the idea of a fall of pink snow to that depth.

That was on August 14, and on June 8 fire had devastated that section, lasting for some two weeks, apparently destroying all possibility of vitality remaining in any seeds. And yet less than two months after there was this profusion of inflorescence.

Whence did that growth originate? Our driver said that it had never been very abundant in previous years, and that it began to start about three weeks after the fire.

But it is of course the *Asters* and *Solidagos*, with a few other *Compositae*, that in the autumn give color to the landscape almost to the exclusion of all the other species.

In eastern Maine by far the most abundant and conspicuous of these is *Solidago* nemoralis, covering the dry rolling uplands with a yellow carpet of great beauty for mile after mile. Along roadsides partly shaded *S. serotina*, var. *gigantea* is the most common.

In moister ground *S. puberula* prevails, and in the extensive swamps *S. uliginosa* is very abundant, vigorous and beautiful.

This region, especially where it is a little swampy, is the paradise of *Asters*, *A. puniceus* being the most abundant and showy. The earliest of all is *A. radula*, which is gradually replaced in southern Massachusetts by *A. spectabilis;* and again in New Jersey by *A. surculosus*. In a few localities *A. Novae Angliae* is very showy and abundant.

In Massachusetts, as autumn approaches, the fields and roadsides are whitened with low, bushy species, which are mainly *A. multiflorus* and *A. vimineus*, which, as we move southward, we find largely replaced by *A. ericoides*.

In the vicinity of Washington, D.C., *Aster tradescanti, diffusus, patens, simplex, undulatus, paniculatus* and *tenuifolius* are often seen in sufficient quantity to give character to the landscape, which *A. linariifolius* is very abundant, and among the pines *A. concolor* is occasionally found in mass, as is its congener, *A. Curtisin*, among the North Carolina mountains.

Among the golden rods which color extended areas are *Solidago bicolor*, with its var. *concolor, erecta, arguta, rugosa, nemoralis, Canadensis* and *lancolata*, while *S. sempervirens* is found in mass, bordering salt marshes from Maine to Virginia.

But perhaps this article is already sufficiently extended to call attention to the point desired to be emphasized, and to suggest to botanists the habit of observing and putting down in their note-books those species which by their abundance give color and character to the landscape, and then occasionally sending to scientific journals the results of such observations, so that future editors of manuals and local floras may be able to give some accurate and reliable notes respecting this long neglected department of botanical research.

BOTANY IN THE SCHOOLS.

BY KATHERINE E. GOLDEN, PURDUE UNIVERSITY,

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THERE has been a great deal published in *Science* upon the subject of biology in the colleges, but little or nothing has been said relative to the teaching of the subject in the common schools. This point was impressed upon me more forcibly upon receipt of some school reports. In the reports, which are prepared by the superintendent of instruction mainly for the benefit of the tax-payers, a statement is made in regard to the various subjects taught, and for those subjects not in the ordinary curricula reasons are given showing their desirability for the pupils.

From the fact that reasons are considered necessary, it would seem to imply that the subjects in question are considered not entirely essential, this being especially true of the subjects that come under the heading "nature study," these usually being botany and a very little zoölogy. There is given usually a tabulated statement of the benefits the pupils derive from their study, the tabulated statement consisting in many cases of the pedagogical principles that a normal school student is crammed with before an examination, or that one hears rattled off so glibly at a teachers' institute.

And yet behind the reasoning and the tabulated statement there is usually a dense ignorance of the subjects. For if the subjects were understood, no person of ordinary intelligence would feel called upon to give apologetic reasons, or would expect that teachers without any previous training in those subjects would be competent to teach them. Trained teachers are provided for music, drawing, physical culture, sewing, cooking, and manual training, who, besides teaching the pupils, meet the teachers at stated times to coach them in the work, so that they also may be fitted to help the pupils. But in "nature study" it is not considered necessary to have a special teacher, any ordinary teacher being supposed capable of mastering the subjects embraced under that head.

Here is an extract from one report:—"Truly it is said that this work must be done in such a way that it shall lead to the love of nature. Here the task-master has no place. Only they who can lead in the spirit of the student have the power that will inspire in the children the needed zeal." This reads beautifully from the rhetorical point of view, but in the connection in which it was used it was the veriest rot, for the writer knew that the teachers, being for the most part graduates of his own high school, in which neither botany nor zoölogy was taught, knew nothing of the subjects. The writer closed his statements by saying that elementary botany had been taught the previous year, and that, when directed by a teacher in sympathy with it, always interested the young.

Botany is the favorite "nature study," because the teacher can make selections of such pretty flowers, with beautifully long names. Then the flower can be separated into its constituent parts, and the name of each part learned by the pupils; this same process can be gone over with other flowers, and all on pedagogical principles of the latest date, for is not the pupil using natural objects, and finding out things for himself by an analytic process?

Now, if instead of frittering away the children's time by "object lessons" of the James Whitcomb Riley "peanut" variety, a competent specialist were to be put in charge of the work, one who would have a scheme of work that was consecutive, and who could instruct the teachers, just as the specialist does in music, drawing, etc., a minimum amount of time devoted to the work in school would give good results, besides taking a burden off the shoulders of the teachers. For the public school teachers are much imposed upon in having to teach subjects of this kind for which they are not prepared, and in many cases do not know how to set about making up for the deficiency. A subject of this kind is sprung on them, so to speak, by the superintendent, who sometimes does not realize what its teaching involves.

It is said that the public schools are overburdened with work, and that they cost too much already; well, if that be so, then drop the subject altogether from the curriculum. If this statement as to overburdenment and cost be not true, then the subject should be taught in a proper manner. And to teach it in a proper manner means to pay for a specialist, who knows the work and who can direct it properly. Not an "object lesson" specialist, but a botanist. And it cannot be expected in this work that a cheap teacher will do, for nearly invariably a forty-dollar man does forty-dollar work. False economy in teaching always involves more or less waste of time and money.

SOME REMARKABLE HOT SPRINGS AND ASSOCIATED MINERAL DEPOSITS IN COLUSA COUNTY, CALIFORNIA.

BY HAROLD W. FAIRBANKS, BERKELEY, CALIFORNIA.

A group of remarkable mineral springs occurs in the valley of Sulphur Creek, Colusa County, on the eastern slope of the Coast Ranges. This section is formed of Cretaceous shales and sandstones, which to the west, in the higher portion of the range, are replaced by an older basement series.

The Coast Ranges, judged from the standpoint of their economic minerals, are characterized particularly by the presence of large deposits of cinnibar. A little to the west of the locality about to be described the cinnibar deposits are seen clearly to be closely related to volcanic phenomena. Mineral springs of every description are more abundant than in any other portion of California. Lava of late Tertiary age covers much of the country in the vicinity of Clear Lake and southward, and it is probable that the springs date from the close of the volcanic activities.

The famed Sulphur Bank at the eastern end of Clear Lake, where has been mined for many years both cinnibar and sulphur, is perhaps the best known of the interesting phenomena in this volcanic region. Almost unknown, however, is the group of remarkable hot springs and resultant deposits of gold and cinnabar in the Sulphur Creek Mining District. Here gold and cinnabar have been deposited from the same solfataric vent, but, what is the most remarkable, both in commercial quantities. While in most mineral regions, as far as our observations have gone, the deposition of minerals has almost if not quite ceased, here it is still going on, and the most excellent opportunities are presented for the study of such phenomena.

It must not be supposed that the gold deposits of Sulphur Creek are typical of the others of the State, for, indeed, they are not. This is the only locality, as far as I am aware, in which gold is found in veins in Cretaceous rocks in California. As a statement of general application it may be said that the epoch of the formation of quartz veins, and the associated gold deposits, ceased before the deposition of the lowest cretaceous beds; that is, following the great upheaval at the close of the Jurassic. Only locally is there apparent any metamorphism in the Cretaceous. The epoch of the cinnibar deposits is very much later, probably beginning at the close of the great volcanic activities following the Miocene, and in rare instances, as in the case under discussion, continuing up to the present time.

About the town of Sulpher Creek is a group of quicksilver mines, several of which show deposits of the usual character, that is, cinnibar distributed in irregular vein form in a gangue of silicified serpentine. The Manzanita mine lies on the north side of the creek, and it is here that the gold and cinnibar are associated in such an interesting manner. They occur in various places over a hill about half a mile in diameter, and which rises several hundred feet from the valley. It is evident that at some past time the whole hill has been thoroughly permeated by hot mineral waters, and either simultaneously or at different epochs, gold deposits were formed from silicious waters in certain spots, while in others cinnibar with more basic solutions almost changed the character of the original shales and sandstones. Cinnibar in small quantities, and often associated with sulphur, can be found over a large portion of the hill. The distinctly gold quartz veins occur on the western side, where great chambers have been excavated in following the veins. Here are thin seams of black quartz, with which calcite is often associated, frozen to the hard silicified walls (originally shale). It is apparent that the quartz was formed in open cavities, not only from the fact that it is always found firmly attached to the walls, but also that open spaces still remain through the centres of many of the veins. These spaces are lined with beautiful drusy crystals of quartz and are sometimes a foot across. The chambers have been worked out down to the water-line, where the gold was found to be largely contained in iron pyrites. In the outer portion of these quartz veins much bitumen is often found, while the centre is sometimes filled with soft white magnesian and aluminous material.

The Manzanita mine was first located for quicksilver but was subsequently worked for gold. In 1891 preparations were being made to save both the gold and the quicksilver, which in many places are found together. At the foot of the hill on the east, where the original works were located, a hot spring still exists. In one of the older workings near this spot beautiful examples of gold and cinnibar in the same hand specimen were obtained. The hot waters were finally encountered, and work in that direction had to cease. An examination of the whole hill shows a remarkable variation in the occurrence of gold and quicksilver with sulphur and bitumen.

The Monticeto mine lies on the south side of the creek just above the town. Gold has been found here in two sandstone strata a little distance apart and inclosed in shale. The sandstone stands vertical, while the gold occurs in thin horizontal seams of a loose sandy character. The adjoining shales are considerably silicified. The largest sandstone stratum has a width of ten feet and has been mined out for some distance on the ore shoot, which dips at an angle of 30°.

The most interesting of all the mines about Sulphur Creek is the Elgin, situated three miles up the valley from the village. Hot springs, still flowing a large amount of water and highly mineralized, issue from a very steep bluff on the south of the creek. Over much of an area, several hundred feet in extent, the formation consisting originally of argillaceous rocks and sandstone, and possibly some serpentine, has been almost completely replaced by silicious and calcareous sinter. The mine is opened by two tunnels, the lower one nearly four hundred feet above the base of the hill, and the upper less than a hundred feet higher up. The lower tunnel has been run in about one hundred and eighty feet with branches and cross-cuts. As one enters, heated air, saturated with moisture and sulphurous vapors, is at once encountered, and all surplus clothing is dispensed with. When well within the tunnel the air grows hotter and more stifling, but one is well repaid by the sights which open to his gaze, and by the feeling that he is witnessing nature at work in her laboratory in a manner which is seldom open to man. The hill seems to have been fissured in every direction. Through these fissures poured mineral waters, once much more abundant than at present, partly or completely filling the cavities and largely replacing their walls by silicious and calcareous deposits. The tunnel seems almost lined with beautifully banded aragonite mixed with silicious sinter of different kinds, varying in color from black to white, and in texture from porous to compact. Much of it is almost glassy and opalescent. Distinctly crystallized silica or quartz is rare. Here and there great cavities stretch away and downward farther than one can see, being completely lined with sparkling crystals of calcite, or stalictitic forms often grouped and branching like huge corals. One mass was observed nearly two feet in diameter, quite spherical, and entirely surrounded by radial stalactites four to five inches long. At the limit of one of the workings water of almost boiling

temperature was encountered. The heat and sulphurous vapors are almost stifling. Here it is that mineral deposition is still going on. Most noticeable is it in the case of sulphur, minute sparkling crystals of which line the cavities. Not only are cinnibar and sulphur present but gold also in small amount. In the lower tunnel a brown bitumen is abundant in the rock cavities. It results from the vaporization of bituminous matter in the deeper seated portions of these cretaceous rocks. The cinnibar for which the mine is being developed occurs impregnating the silicious sinter and aragonite, evidently having been formed with them. In exploring the deeper and hotter portions of this mine but little stretch of the imagination is needed to picture oneself within the very bowels of the earth.

In the upper tunnel is well illustrated the cooler conditions requisite for the deposition of sulphur. While in the lower tunnel it is found in comparatively small amount, in the upper the rock is richly impregnated with sulphur crystals. The cavities of the brecciated sinter fairly sparkle with them.

On the north extension of the Elgin, sulphur works have been opened for the mining of sulphur, which exists mixed with soft friable tufas of a variable appearance and composition.

A careful study of the Elgin mine would be a means of making one familiar with the formation of sulphur and cinnibar in the coast ranges. While the conditions are of course not all alike, the springs varying in temperature and composition, the manner of deposition is everywhere much the same for these minerals.

LETTERS TO THE EDITOR.

*** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as a proof of good faith.

On request in advance, one hundred copies of the number containing his communication will be furnished free to any correspondent.

The Editor will be glad to publish any queries consonant with the character of the journal.

The Data of Bird Flight.

IN *Science* for Jan. 26, 1894, p. 46, Mr. C. F. Amery, commenting on Professor Langley's recent "Internal Work of the Wind," makes inroads into what had seemed to be the fund of accepted observational data in regard to bird flight—soaring flight in particular. Possibly there is not to be found in print any deliberate and detailed summary of the bare, unexplained, facts of the bird's performance, upon which there is agreement among recent students of the subject, but a considerable list of accordant observations may readily be made up from the several notable papers of the last few years, which have dealt with the general problem from a new experimental point of view. The interested public is aware that the whole matter of air-navigation has of late been taken up *de novo*, by searching inductive methods, and it is fairly to be inferred that renewed observation of soaring birds, in connection therewith, has been more orderly and appreciative of essentials, hence more definite and trustworthy. It is, therefore, disconcerting to the non-specialist to find seemingly fundamental data of the investigation discredited.

Mr. Amery affirms, in effect, that the soaring bird cannot keep up to a level course in straight onward flight, whatever the motion, bodily or differential, of the air through which it passes; that it is by circling that altitude is maintained or gained. Yet it is a matter of frequent comment in regard to the sailing flight of certain sea birds, notably the "wandering" albatross, that they perform just this feat. Circling is the persistent habit of the soaring land birds, of which, among many competitors, the eastern vulture is perhaps past-master for varied skill; and there is conspicuous suggestion of a cause-and-effect relation in sustained circle-soaring. But the sea bird travels a wider field, and more commonly sails a straight course; moreover, its normal plane of flight is not at high altitudes, but within the possible vertical range of the seagoing observer, whose interest, furthermore, the bird reciprocates—in fact, if not in kind—so that its performance is brought into notice at short range. And the burden of testimony is that, in air conditions ranging between extremes of storm and calm, the albatross and other sea birds do, in fact, for long distances, travel the wind on undeviating courses, in virtually effortless flight. It has been my opinion that this paradoxical statement was yet a statement of fact, and that it was only the diverse explanations of this and other similarly puzzling phenomena that were in controversy.

For several years I have been an attentive observer of soaring birds, but my incentive has been limited to the interest of verification for myself of what were believed to be the accepted data of the modern investigation. Mr. Amery's dictum puts us (or at least myself) all the more into disorder because there is seemingly no recognition that, from such a postulate, we must undermine a body of doctrine.

If, perhaps, it is I, as a non-specialist in the audience, who am the one in fault, then there is compensation in the added value my verification-notes will have acquired, as contributions to a question still open. On that contingency I draw upon them here.

The best representatives of the air-sailers, among sea and land birds respectively, of which I have had opportunity for close observation, have been the remarkably tame gulls of San Francisco Bay, and the hawks of the Rocky Mountain region. The gulls are tamed by the ferry passengers, who feed them with crumbs, to be caught on the wing. They follow alongside, a little beyond arm's length. In a wind of moderate strength (I am not able to speak with certainty about directions) they will for some minutes maintain, without wing stroke, fixed positions, with reference to the boat, as steadily as though perched on the rail. In review of the lines of spectators, they abruptly drift forward and backward, and rise and sink between deck levels. As with flies in the air of a railroad car, the general forward course appears to be no matter of their concern. These subordinate motions are all in the vertical plane of the general forward motion—parallel to the boat's side, just beyond cane and umbrella reach. To the vertical plane, the line of the wings is held unvaryingly at right angles. Upon this steady horizontal axis there is, however, rotation at the shoulder; but barely perceptible in amount, and quick, with momentary pauses, discontinuous, and unrythmical—apparently an exceedingly alert and vigilant balancing process. The tail is slightly and slowly opened and closed, fanlike; and slightly, but quickly, tilted sideways, and up and down. The head is moved deliberately, in all directions, with the effect of a quiet glance, independent of the general nervous activity. At an increased distance, as with the leaning ship that has carried the roar of the wind in its sails beyond hearing, only the easy poise is noted. Occasionally a gull will venture to alight on the pilot house. He wheels into position, and, the feet hanging downward, connection is made through the last inch or two carefully, as in train-coupling with both sections in motion; but the wings remain fully extended until the body is at rest, when they are folded in gently, as though pains must be taken to avoid again catching the wind. If startled from his perch, he makes a strong wing stroke, and slants swiftly backward and downward; but the usual mode is a repetition, in reverse, of the alighting process: without the initial impulse of a stoop and spring, he floats outward and upward, ahead of the boat; then, perhaps, circles into place

alongside. In dead calm, few birds leave the ferry slips for the trip, and these labor heavily across in flapping procession.

From observation of land birds I have but one note of interest. It relates to the repeatedly observed feat of a small hawk. In this instance there is no advance in any direction. Like the humming-bird he stands poised, without visible support, at a point in space; but his outspread wings and tail are as steadily held as if wired into place by the taxidermist. He points straight into the wind. If he utilizes its shifting "internal forces," he draws upon them, with extraordinary expertness, for a constantly recompounded resultant, to be maintained equal, and vertically opposed, to the pull of gravity. With almost the suddenness of the humming-bird, he will dart from one fixed position to another, seemingly by expenditure of will power only. I believe that it is high winds alone that afford him this sport, or opportunity. And I have never seen him thus poised over level ground, but among hills, even with their summits, and from one to another, close in their lee, like the humming-bird, again, in a garden. On two occasions I have had a fine chance at this skilled aeronaut, from surveying stations on hill tops. I have been able to keep him for several minutes on the cross-hairs of my telescope. As with the sailing gull, there is the same calm eye and the same quick and delicate teetering of the wings; but the individual feathers, excepting at their strongly up-bent tips, exhibit no blur of continuous motion.

If my opinion in regard to such observations as these be correct, Mr. Amery's assertion is disproved, and belongs to a stage of the investigation beyond which we have advanced.

WILLARD D. JOHNSON.

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The Mining Building at Chicago.

To what Mr. G. L. English so well says in *Science* of Feb. 16, in defence of the gallery exhibits against the slurs of the anonymous article in *Science* of Feb. 2, on "The Columbian and the Centennial Expositions," I wish to add a word for the "ground floor." Much of the fault found by the writer of the article in question was deserved, but if he had looked for points of merit as well as of demerit he would readily have found them. The exhibit of New South Wales was wonderful for its extent, variety and completeness. It was a strictly economic display but not without scientific features as well. Everything in it was plainly numbered and labeled, and full descriptive catalogues with corresponding numbers were to be had freely on application. The Canadian Geological Survey made a very complete display of rocks, minerals and ores, in which specimens and groups were carefully arranged and plainly labeled, but the Canadians made an excellent showing at the Centennial and might therefore have been excluded from the comparison by this anonymous correspondent. Pennsylvania, New York and Michigan made displays of their great specialties of production, which were well mounted and cased where necessary and were plainly labeled. New York's geological obelisk was certainly of greater educational than technical value, while the needle of Pennsylvania anthracite coal representing the exact section of a single bed was instructive as well as impressive. North Carolina, New Jersey and Missouri aimed to have their exhibits of direct educational and scientific as well as economic value. New Jersey took especial pains to have her ores, minerals, clays and marls distinctly labeled and to put the labels where they could not be overlooked, while a complete series of the geological maps of the State adorned the walls of the space assigned to her. The Missouri exhibit was labeled with the common as well as the scientific name and the chemical composition of each group of minerals or ores represented, in addition to the printed and written labels on each specimen. About 75 framed maps, charts, diagrams and photographs were displayed in this exhibit each of which bore an adequately descriptive label. The "great piles" of ore and metal here had a definite meaning, which was plainly stated on a large label prominently placed. I might go on and mention many points of excellence in other exhibits on the ground floor, without going into details as to the instructive array of mining, milling and quarrying machinery on exhibition, but I have said enough to show that there were more than "one or two" exceptions to this correspondent's strictures. The general public seemsd, indeed, to care more for the Ada Rehan statue than it did for education in mining, mineralogy, or geology, but that is not the fault of the exhibitors who strove to instruct as well as to interest those who strayed into their spaces in the Mining Building, and I quite agree with Mr. English in thinking that the mining exhibit at Chicago far exceeded that at Philadelphia in every respect, though of course any one at all versed in the matter could detect many defects which might have been remedied.

E. O. HOVEY.

New York, March 1.

Petrified Eyes.

IN *Science* of Feb. 2 Mr. Geo. G. Groff, under the title of "Petrified Eyes," calls attention to a statement in some popular school geology that "huge saucer eyes," of a thirty-foot monster, were so perfectly petrified that the "lenses have been split off and used as magnifiers."

About a hundred years ago some students of Palæontology, at Heidelberg, made to represent fossils, out of clay, spiders in their webs, snails with antennæ perfectly preserved, a plump mouse, and other similar things, and left them where they could be found on class excursions. The professor described and pictured them in a book as remarkable fossils. On a latter excursion he found his name fossilized. He gradually realized that he had been hoaxed, and chagrin hastened his death.

Ever since then it has been established that only chitinous, horny, or bony parts of an animal are petrified; soft parts are never petrified. They may leave impressions in a fine soft mud, as the examples of jelly-fish in the Solenhofen—Bavaria—stone so well show. The outlines of the body of worms, fish, reptiles, mammals, are preserved by the shaping of the mud in which they were deposited—not by the membranes themselves being chemically replaced. This is true even of the tougher membranes of the body, as for instance the hide, and much more so with any part as delicate as the crystalline lense. The ease with which the lense is destroyed is shown by one of the three methods employed in treating *cataract* of the eye, where by means of needles the lense is broken up and is finally absorbed by the fluid in the anterior of the eyeball.

Quarrymen seem to delight in finding "fossil eyes," as they name many things from the teeth of *Gyrodus* to quartz boulders.

While the lense could not be petrified, the bony eye cavity, or the cavity formed by the sclerotic ring possessed by many fishes and reptiles (*e.g.*, *Portheus*, *Ichthyosaurus*) could be filled with gypsum, calcite, or quartz in such a manner as to furnish a plano-convex lense.

A. R. CROOK.

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BOOK REVIEWS.

Economic Geology of the United States; with briefer mention of foreign mineral products. By RALPH S. TARR, B.S., F.G.S.A., Assistant Professor of Geology at Cornell University. New York, Macmillan & Co., 1894, 509 p., 27 figs., 2 plates.

PROFESSOR TARR prepared this treatise to accompany his lectures on economic geology. In the preface he states that foreign localities have been referred to only where their importance or their bearing on the genesis of materials is noteworthy. The matter has been largely compiled. The author has himself studied in connection with official surveys many different areas in the United States, and one can see that he has brought much of his field observation to bear upon the treatment of his subject. The book deals with common rock and vein-forming minerals; rocks of the earth's crust, which are illustrated by an abstract of the admirable tabulation of igneous rocks made by F. D. Adams on the basis of Rosenbusch's system; physical geography and geology of the United States; origin of ore deposits; mining terms and methods; metalliferous deposits; non-metallic mineral products, including coal, petroleum, natural gas and asphaltum, building stones and cements, soils, clays, fertilizers, artesian wells and mineral waters, precious stones, abrasive materials, salt, miscellaneous minerals and general summary of mineral production.

The need of a hand-book of the economic geology of the United States has long been felt, and the works by Kemp and Lakes on ore deposits published in 1893 but partially covered the field which Professor Tarr has traversed in his generally lucid and engaging style. It is a drawback to a treatise on this subject that so far as it depends upon the merits of its tabulated statistics and of its description of existing processes in the arts of mining and manufacture, so sure is it shortly, with the rapid improvement and alteration in mechanical devices, to be discarded as out of date. While Professor Tarr has brought the statistics of production down to so late a date as the year 1892, the scope of the work and the method of treatment will recommend it for use as a text-book for undergraduate collegians long after its statistical information has ceased to be of practical utility. The real problems of economical geology, so far as they are distinct from those of geology proper, must usually be solved by the capitalist and producer. They are such questions as concern the relations of products and by-products, proximity to fuel, fluxes and markets, and are of themselves ever variable in their relations, though tolerably fixed in principle. While this side of the subject is generally least familiar to the geologist, and while our author makes no pretense in his headlines of discussing it, the student will find these important considerations have not been overlooked in the treatment of particular products.

The classification of ores used makes origin of primary and form of secondary significance. The detailed information which follows appears to fall clearly and easily into the groups formed upon this basis.

The local geologist will note some unimportant mistakes, which have doubtless been perpetuated through compilation. Thus it is stated that a few thousand tons of coal are annually produced from the New England coal basin, a statement which was true several years ago. By a slip of the pen, on p. 124, the author makes the "Huronian a division of the Archæan," instead of the Algonkian, as it is given in the table on p. 47. These errata may be readily corrected in a second edition. The press-work is of high order; there is a copious index and an appendix of useful reference books.

An Introduction to the Study of Petrology. By FREDERICK H. HATCH, Ph.D., F.G.S. London, Swan, Sonnenschein and Co.; New York, Macmillan and Co., 2nd edit., ill., 128 p., 90 cts.

THOUGH not new in point of publication, this small work, now in its second edition, continues to be the only elementary treatise on petrology in our language. It is not intended for children but for those older students who may be entering upon the microscopic study of rocks, or for those workers in other fields who may wish to understand something of the manner and methods of modern research in lithology. The book is well illustrated with cuts, drawn in many instances from the works of Rosenbusch, Fouqué and Lévy, Bonney, and Teall.

The Technique of Post-mortem Examination. By LUDWIG HEKTOEN, M.D. Chicago, Ill., W. T. Keener Co.

IN this little book of 170 pages Dr. Hektoen has supplied a lack in our literature. Here are given careful directions for ordinary post-mortem study, describing in detail necessary instruments, general methods of procedure, general points to be noted and the proper methods of keeping data. The book is illustrated with forty-one figures, and is excellently designed for the purpose of guiding the inexperienced physician in making autopsies to the best advantage, obtaining the greatest results therefrom, and keeping his records in the most satisfactory manner.

Le Cuivre. Par Paul Weiss, Ingénieur au Corps des Mines. Paris, Librairie J. B. Baillière et Fils. 1894, 96 figs., 344 p. Cartonné 5f.

IN this volume M. Weiss has presented a very useful work on copper, designed not particularly for specialists, but rather for engineers and others who desire a clear general understanding of the metal, either from the standpoint of its position in economic geology, its chemistry, or its metallurgy. The work is divided into three parts, the first of which treats, in brief but sufficient detail, of the origin of copper and of its ores, of its physical properties and of its alloys. The second part treats of the metallurgy from the roasting of the ore to the refining of the last malte, including descriptions of the Bessemer copper process and of electro-refining. Part third describes the applications of copper, the market, the employment of the metal in electricity and finally the copper foundry and the manufacture of alloys, bronzes and brass. In this connection are given several reproductions of photographs showing the well-known works of M. Weiller at Angoulême. Tables of tensile strength, limit of elasticity, etc., for the various alloys, complete the volume. In treating of the origin and formation of the ores of copper the author, naturally, may be, but with reason, rejects the exclusive lateral secretion theory, as advocated particularly by some German authors, in favor of a fumerole action contemporaneous with the solidification of the basic rocks, the final position of the mineral, or metal, however, being determined by the action of circulating waters. The chapter on the molecular structure of copper alloys, being principally the experiments of M. Guillemin, is one of the most interesting. The examination under the microscope, after etching a polished surface with an appropriate reagent, shows remarkable difference in molecular structure corresponding with differences in chemical composition. Some thirteen micro-photographs are reproduced in illustration of the text, and it may be added that throughout the book is most excellently illustrated and is thus given a decidedly increased value to the general reader.

The Fauna of the Deep Sea. By SIDNEY J. HICKSON, M.A. New York, D. Appleton & Co. Modern Science Series.

THIS volume of the Modern Science Series is one of the attempts at popularizing a subject which is of exceptional interest to scientific readers. The publication of the various deep sea exploring expeditions are too detailed and too technical for the comprehension of the ordinary reader. In this little book of 170 pages Mr. Hickson has attempted to collect all of the essential and interesting results of the study of the fauna of the bottom of the ocean. He gives us a short history of the investigations and describes the conditions of life at the bottom of the sea. The laws of distribution of fauna in different zones of the depths are explained, and then follows an outline of the discoveries in regard to each group of animals as they exist at the bottom of our deep seas. As a popular account of an interesting scientific subject this little volume is successful, and will enable a general reader to answer the most commonly asked questions as to the conditions of life at the bottom of the sea. It is illustrated with twenty-three figures.

Physiological Practicums. By Prof. B. G. WILDER. Press of the *Ithaca Journal.*

UNDER this title Professor Wilder has published as a series of separate slips the directions for labratory work which he furnishes his students in Cornell as guides in the study of mammalian anatomy. Accompanying the laboratory directions are a series of twenty-nine figures on separate slips of paper. From these notes one can gain an adequate knowledge of the method of laboratory work pursued in Cornell, and an instructor who has similar work to do will find the notes of practical value. Exactly why Professor Wilder calls them physiological practicums does not appear, for there is no physiology involved in the work. The practicums cover nothing but general anatomy of certain of the organs of mammals, and any teacher who obtains them with the hope of getting assistance in practical physiology will be disappointed. The practicums, of course, bristle with Professor Wilder's peculiar terminology, a matter not to be deplored perhaps except in the case of the brain. It does seem to be superfluous to introduce here an entirely new set of terms which will be of no value to the student outside of the special text books published by Professor Wilder.

Darwiniana Essays. By Prof. H. HUXLEY. New York, D. Appleton & Co.

ASIDE from Mr. Darwin himself there is certainly no writer who has contributed so much to the general extension and acceptance of the evolutionary doctrine as Professor Huxley. From the first appearance of the origin of the species Professor Huxley has been its champion, and from time to time his clear brain and lucid pen have given to the public essays upon one and another phase of the general studies inaugurated by Darwin. These essays have appeared at intervals from 1859 until 1888, the last one constituting an obituary on Mr. Darwin. The essays scattered in various publications have been finally collected in one little volume, and to them have been added a series of six lectures upon the general subject of the causes and phenomena of organic matter delivered to working men in 1863. Taken together the essays comprise Mr. Huxley's valuable contributions to the general subject of evolution, and one can clearly discern in reading them one after the other the strong influence their author has had upon this growing conception of science. There

is no need of extended notice of the separate essays, which are so well known to scientists, but their publication together, assisted by the preface, tells us that as a unit they still represent Mr. Huxley's views upon evolution and that he has in later years not swerved to any great extent from the position adopted even in the first essay. This collection of essays of Darwinian hypothesis certainly forms a valuable addition to one's library on evolutionary topics. The title is unfortunate, for Professor Huxley has chosen the same title which has been earlier used by Professor Gray for a similar book, and two books with the same title are sure to produce confusion.

Guide to the Study of Common Plants. An Introduction to Botany. By VOLNEY M. SPALDING, Professor of Botany in the University of Michigan. Boston, D. C. Heath and Co., 246 p., 1884, 85 cts.

THIS little book will doubtless prove of great assistance to many teachers of botany in the elementary classes. The author has given an admirable series of exercises, developing a natural and practicable method in the elementary study of plants and plant life. The publication has been suggested by the frequent inquiries of teachers regarding the preparation in botany required for admission to the University of Michigan.

Summer Birds of Green County, Pa. By WARREN JACOBS. Waynesburg, Pa., Republican Book and Job Office.

Bird Life in Labrador. By WINFRED A. STEARNS. Amherst, Mass. $1.

THE first of these is a brief pamphlet giving a list of the summer birds of Green County, with a note or two as to their habits.

The second is a somewhat more extended account of the birds of Labrador and takes partly the form of a narrative of Mr. Stearns's journey in that country. It contains no descriptions of the birds but more in regard to their habits and abundance.

—S. C. Griggs and Company of Chicago have published a book by John P. Davis on "The Union Pacific Railway," which gives a history of the railway in question from its origin to the present time, with special reference to its relations with the United States Government. It tells how the idea of a trans-continental railway originated and how for many years its realization was prevented by the difficulties of the work and the influence of sectional jealousies. The successive attempts that were made to obtain a charter are recounted, with an analysis of the charter under which the road was actually built. A chapter is also devoted to the operations of the Credit Mobilier and the legislative scandal that arose in consequence. The author is inclined to excuse the operations in question on the ground that they were no worse than occurred in the building of other railroads in those days; and yet in his preface he says, speaking of the Union Pacific: "The agencies through which this particular instrument was obtained and applied to use will be found seriously out of harmony with settled political and moral principles." In conclusion, Mr. Davis considers briefly what steps the government ought to take to recover the sum due it from the railway company, which will amount at the maturity of the bonds in 1899 to $125,000,000. He notices several plans that have been suggested, but comes to no definite conclusion as to which is the most advisable; so that on the practical aspect of the subject he does not shed much light. As a history of the railway, however, the book will doubtless be of use.

EXCHANGES.

[Free of charge to all, if of satisfactory character. Address, N. D. C. Hodges, 874 Broadway, New York.]

FOR SALE OR EXCHANGE.—Safe, nearly new, 1,150 pounds. Will sell cheap, or exchange for a Safety Bicycle, Gasoline Engine, Music Instruments, or anything that may suit. Safe has been used but little and is as good as when bought. Address, A. Lagerstrom, St. Peter, Minn.

LIVING near the famous "Serpent Mound," Adams County, Ohio, I have had opportunity to make a collection of pre-historic relics. I will sell same to any one interested in archæology. Write me. Warren Cowen, Elmville, Highland County, Ohio.

TO EXCHANGE.—Herbarium specimens. Address, H. P. Chandler, Beaver Dam, Wisc.

KARYOKINETIC FIGURES IN MAMMALIAN TISSUES.—Since the publication of my Preliminary Notice in *Science* for Dec. 1, 1893, many parties have written me asking for permanent preparations showing mitosis. To these parties I have sent slides, and I now offer to all who desire them slides showing mitotic figures in nuclei of embryo kitten. A good immersion objective is necessary to make out the figures satisfactorily. Send 60 cents in stamps. If the slide is not satisfactory, return it, and I will return the money. I do not care to exchange slides. Frank S. Aby, State University, Iowa City, Iowa.

FOR SALE.—A small collection of bird skins, consisting of 135 specimens of New England species, most of which are in good condition and all have full data. Nearly all were collected in the Connecticut valley in Massachusetts. Price, $10. Address, H. L. Clark, 3922 Fifth Avenue, Pittsburgh, Penna.

FOR SALE.—Price $150, cost originally between $300 and $400, a microscope and following accessories: Acme (No. 2), stand and case lost, $75; Crouch, one-fifth collar adjustment ann objective, $25; Tolles, four-tenths ditto, $45; Tolles amplifier, $12; Baush and Lamb, half solid eye piece, $8; Baush and Lamb, acromatic condenser, $18; Hartnock Polarizer, $30; turn-table, $6; Hartnock, camera lucida, $20. D. T. Marshall, Metuchen, N. J.

TO EXCHANGE.—Works on entomology, botany and palaeontology for works on Indians and archæology. H. Justin Roddy, Millersville, Pa.

WANTS.

WANTED.—A young man to canvass for advertisements for *Science*. The usual commission of thirty per cent will be paid. Apply in person at *Science* Office, 874 Broadway, New York.

DOUBLE honor graduate in Science and Philosophy desires any suitable work in science, of the nature of teaching preferred. Address, E. A. Beckett, Trinity College, Toronto, Ontario.

WANTED.—Theory of the Earth, by Hutton. Principles of Geology, by Lyell. Manual of Geology, by Phillips. Lehrbuch der Geolgie und Petrefacenkunde, by Carl Vogt. Etudes sur le Métamorphisme, by Daubrée

WANTED.—Second-hand books on osteology, embryology, and comparative anatomy. Send list, stating condition and cash price. Can offer a few good sets of birds' eggs if desired. R. C. McGregor, Palo Alto, California.

WE are engaged in a study of the geographical distribution and osteology of our North American Box Tortoises or *Terrapene* (*Cistudo*). Specimens from Georgia, Tennessee, Alabama and the Dakotas are especially desired. Material from other localities would be welcomed. Would gladly pay expressage and return specimens if desirable. Specimens should be enclosed in a small box with but little paper (without alcohol) and addressed, W. E. Taylor, Walker Museum, University of Chicago, Chicago, Ill.

WANTED.—Addresses of persons interested in archæology. Copies of the new archæologic journal in exchange for lists of collectors. A collection of 10,000 valuable objects, the results of my nine years' exploration in the Mississippi Valley, for sale. Price, $7,650. Warren K. Moorehead, Waterloo, Indiana.

WANTED.—Extracts made from departmental libraries or archives, and from the Congressional Library at the National Capital; languages translated by an experienced linguist. Address, "Translator," 2020 Fifteenth Street, N.W., Washington, D. C.

WANTED.—(1) Data of Cases of Contagious Mental Disorders; (2) "Anatomy of Suicide," by Forbes Winslow; "English Suicide Fields," Radcliffe. State date and price of (2) and (3). Address, James Wood, M.D., 160 St. John's Place, Brooklyn, N. Y.